

# Eve M. Vavagiakis

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## RESEARCH INTERESTS

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**Cosmology and astrophysics**, analyzing maps of the cosmic microwave background (CMB) to study galaxy clusters, galaxy evolution, neutrinos, dark energy, and fundamental physics.

**Cryogenic receivers and astronomical instrumentation**, designing and developing cryogenic instrumentation for CMB and sub-mm measurements.

**Applied superconductivity in cosmology/astronomical survey devices**, measuring low-temperature devices including transition edge sensor bolometers and SQUIDs to study device physics and deploy next-generation detector arrays.

## EDUCATION

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**Cornell University**, Ithaca, NY

Ph.D., Physics 2021

Thesis: *Measuring the Sunyaev-Zel'dovich Effects with Current and Future Observatories*

M.S., Physics 2017

**Cornell University**, Ithaca, NY

B.A., Physics with Astronomy Concentration 2014

## APPOINTMENTS

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**NSF Astronomy and Astrophysics Postdoctoral Fellow**, Cornell University 2022 –

**Postdoctoral Research Associate**, Cornell University, Ithaca, NY 2021 – 2022

**Graduate Research Assistant**, Cornell University, Ithaca, NY 2019 – 2021

**Provost Diversity Fellow**, Cornell University, Ithaca, NY Spring 2021

**NSF Graduate Research Fellow**, Cornell University, Ithaca, NY 2015 – 2019

*Advisor: Prof. Michael Niemack. Atacama Cosmology Telescope, CCAT-prime, CMB-S4, and Simons Observatory Collaborations*

**Research Fellow**, Caltech, Pasadena, CA Fall 2014

*Advisor: Prof. Jamie Bock. CIBER-2 project*

**Undergraduate Research Assistant**, Cornell University, Ithaca, NY 2011 – 2014

*Advisor: Prof. Gordon Stacey. SOFIA and ZEUS-2*

## HONORS AND AWARDS

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National Science Foundation Astronomy and Astrophysics Postdoctoral Fellowship 2022 – 2025

Provost Diversity Fellowship, Cornell University 2021

National Science Foundation Graduate Research Fellowship 2014 – 2019

Stirling A. Colgate Travel Award 2017

Dr. Gerald A. Soffen Memorial Fund Travel Grant 2014

Cranson W. and Edna B. Shelley Award for Undergraduate Research in Astronomy 2013

Tony Alt Memorial Foundation Scholarship 2010 – 2014

Dean's List Scholar, Cornell University 2010 – 2013

## RESEARCH COLLABORATIONS

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- Advanced ACTPol** (2015 – Present): Analysis of CMB maps for cosmology and astrophysics. Screened TESes and SQUIDs, remotely observed using the Atacama Cosmology Telescope on Cerro Toco in northern Chile.
- CCAT-prime** (2017 – Present): Leading design and development of first light instrumentation for the Fred Young Submillimeter Telescope, a high-throughput 6-meter sub-mm and mm telescope on Cerro Chajnantor being built in northern Chile.
- CMB-S4** (2018 – Present): Superconducting film and detector testing for the next-generation ground-based CMB effort uniting the experimental cosmology community.
- DeepSkies Lab** (2022 – Present): Applying machine learning to astrophysics research.
- Simons Observatory** (2016 – Present): Detector testing, magnetic shielding requirement development, cryogenic testbed development, and SZ analysis pipeline work for an array of CMB telescopes being built on Cerro Toco. Co-lead, Education and Public Engagement Working Group.

## PAST RESEARCH COLLABORATIONS

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- CIBER-2** (2014): Designing a shielding pop-up baffle for the second generation sounding rocket-borne Cosmic Infrared Background Experiment.
- SOFIA** (2011-2014): Designing and testing prototype Miniature Cryogenic Scanning Fabry-Perot (MCSF) interferometers for the FORCAST instrument on the Stratospheric Observatory for Infrared Astronomy.
- ZEUS-2** (2011): Writing a data reduction program for the second generation sub-mm grating spectrometer for the CSO and APEX.

## PRESENTATIONS

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<i>Invited Talk</i> , NASA Goddard Space Flight Center Colloquium, Greenbelt, MD	2022
SPIE Astronomical Telescopes + Instrumentation Conference, Montreal, CA	2022
SZ Workshop, Flatiron Institute, NY, NY	2022
<i>Invited Talk</i> , UH Manoa Institute for Astronomy Colloquium, Honolulu, HI	2022
APS April Meeting, NY, NY	2022
Cornell University Galaxy Lunch, Ithaca, NY	2022
<i>Invited Talk</i> , Kavli Institute for Particle Astrophysics & Cosmology Tea (Virtual)	2021
<i>Invited Talk</i> , CMB-S4 Collaboration Meeting (Virtual)	2021
<i>Invited Talk</i> , UC San Diego Cosmology Journal Club (Virtual)	2021
American Astronomical Society 238th Meeting (Virtual)	2021
<i>Invited Talk</i> , Max Planck Institute for Astrophysics Seminar, Garching, Germany (Virtual)	2021
<i>Invited Talk</i> , CMB-S4 Collaboration Meeting (Virtual)	2021
Cornell University Astrophysics Lunch, Ithaca, NY (Virtual)	2021
Applied Superconductivity Conference (Virtual)	2020
<i>Invited Talk</i> , Wells College Science Colloquium, Aurora, NY	2019
<i>Invited Talk</i> , Tompkins Cortland Community College, Dryden, NY	2019
Low Temperature Detectors Conference (Winner, Best Poster Video), Milan, Italy	2019
CMB-S4 Collaboration Meeting, Fermilab, IL	2019
SPIE Astronomical Telescopes + Instrumentation Conference, Austin, TX	2018
Center for Computational Astrophysics, Flatiron Institute, NY, NY	2018
<i>Invited Talk</i> , St. Xavier's College, Kathmandu, Nepal (Virtual)	2018

Cornell University Galaxy Lunch, Ithaca, NY	2018
APS DPF Conference, Fermilab, IL	2017
Cornell University Summer STEM Colloquium, Ithaca, NY	2017
American Astronomical Society 230th Meeting, Austin, TX	2017
Cornell University Astrophysics Lunch, Ithaca, NY	2016
SPIE Astronomical Telescopes + Instrumentation Conference, Montreal, CA	2014

## GRADUATE STUDENT MENTEES

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Lawrence Lin, Cornell Physics PhD student	2022 – Present
Rodrigo Freundt, Cornell Astronomy PhD student	2021 – Present
Ben Keller, Cornell Physics PhD student	2021 – Present
Zachary Huber, Cornell Physics PhD student	2020 – Present
Cody Duell, Cornell Physics PhD student	2018 – Present

## UNDERGRADUATE STUDENT MENTEES

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Colin Murphy, Cornell '25	2022 – Present
Hanzhi Tan, University of Chicago '24	2022
Ioana Cristescu, University of Richmond '24	2022
Brian Zhang, University of Chicago '25	2022
Photon Xu, Cornell '22	2021
Dontae Milner, Eastern Illinois U., Simons-National Society of Black Physicists Program	2020
Pedro Guicardi, Cornell '22	2019 – 2020
Kshama Malavalli, Cornell '21 → Graduate student at the Carl Sagan Institute	2019 – 2020
Willow Martin, Cornell '22	2019 – 2020
Dallin Richards, Cornell '23	2018 – 2019
Noah Sailer, Cornell '19 → Physics PhD student at UC Berkeley	2017 – 2019
Kaiwen Zheng, Cornell '18 → Physics PhD student at Princeton University	2016 – 2018
Tracy Paltoo, Adelphi University, LSAMP Program → Civil Engineering Project Analyst	2016
Prabudhya Bhattacharyya, Cornell '16 → Physics PhD student at UC Berkeley	2015 – 2016

## SERVICE

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### Simons Observatory:

Team Lead, SO APS-IDEA Team	2022 – Present
Co-chair, Engagement, Mentorship, and Climate Committee	2020 – Present
Member, Equity, Diversity, and Inclusion group	2016 – 2020
Member, Education and Public Outreach group	2016 – 2020
Member, CCAT-prime Collaboration Publications and Speakers Committee	2022 – Present
Co-organizer, Cornell Laboratory for Elementary-Particle Physics Seminar Series	2021 – 2022
Group Safety Representative, Physical Sciences Building, Cornell University	2019 – 2021
Organizer, Cosmology Journal Club, Cornell University	2017 – 2019
Peer Reviewer, NSF GRFP Fellowship Review Sessions, Cornell University	2015 – 2019
Panelist:	
Comm 5660, Science Communication Workshop, Cornell University	2022
NSF GRFP Information Sessions, Cornell University	2017 – 2018
Physics Graduate School Information Session, Cornell University	2015

Reviewer:

*IEEE Transactions on Applied Superconductivity*  
*MIT Press*  
*Physical Review D*

## TEACHING EXPERIENCE

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### Cornell University

*Grader*, Physics 3318: Analytical Mechanics Spring 2021  
*Grader*, Physics 3317: Applications of Quantum Mechanics Fall 2016 – 2020  
*Grader*, Physics 6562: Statistical Mechanics Spring 2020  
*Grader*, Physics 7645: Particle Physics Spring 2018 – 2019  
*Teaching Assistant*, Physics 3314: Intermediate Mechanics Spring 2016  
*Private Physics Tutor*, Physics 1102: Electricity, Magnetism and Waves Spring 2016  
*Teaching Assistant*, Physics 1101: Mechanics and Thermodynamics Fall 2015  
*Physics Tutor*, Cornell University Learning Strategies Center 2012 – 2014  
*Undergraduate Teaching Assistant*, Physics 1112: Mechanics Spring 2011

### California Institute of Technology

*Teaching Assistant*, Physics 1: Mechanics Fall 2014

## TRAINING

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Cornell Center for Teaching Innovation Research and Practice of Teaching Symposium 2022  
NextGen Professors Program, Cornell University 2019 – 2020  
*Selective career development program for participants dedicated to advancing EDI*  
Cornell Center for Teaching Innovation GET SET Workshops:  
Best Practices for Large Lecture Classes 2020  
Enhancing Your Teaching with Research-Based Principles 2020  
Writing a Teaching Statement 2019  
Grading Effectively 2019  
Using a Case-Study Approach to Teaching 2019  
Digital Storytelling 2019  
Incorporating Experiential Learning in Your Classes 2019  
Science Communication Workshop (COMM 5660), Cornell University 2019  
ComSciCon-Cornell, Cornell University 2018  
*Selective science communication workshop*  
CMB Data Analysis Summer School, University of Michigan 2016  
Teaching and Learning Physics (PHYS 4484), Cornell University 2011

## PUBLIC OUTREACH AND ENGAGEMENT

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ParticleBites, the high energy physics reader's digest blog:

Co-director 2018 – Present  
Author 2016 – 2018  
Talk at Sustainable HEP: Tanedo, Vavagiakis, *Year of ParticleBites*: 2022  
*Re-imagining a reader's digest of high-energy physics for community building in an ecosystem of remote collaboration*

Social media: ACT, CCAT-prime, Simons Observatory, ParticleBites 2017 – Present  
Reaching a global audience of >100,000/month

## Media interviews:

Twinkl Educational Publishing House Podcast	2022
Into the Impossible Podcast	2022
Cornell Chronicle	2017, 2022
Tidbits of Research Podcast	2020
WHCU 97.7 Ithaca	2019
WPRB 103.3 Princeton	2018
<i>Invited talk</i> , CMB-S4 Saturday Science Series, Virtual, audience of 47	2022
<i>Invited talk</i> , Warrior-Scholar Project STEM Academic Boot Camp, Cornell, Ithaca, NY	2022
<i>Invited talk</i> , Cornell Friends of Astronomy Symposium, Ithaca, NY	2019
Science on Tap talk, Organized by Graduate Women in Science, Ithaca, NY, audience of 55	2019
Xraise Cornell High Energy Synchrotron Source (CHESS) Outreach Program:	
Tour Guide, leading public tours of Wilson Synchrotron Lab	2017 – 2019
Video development: An introduction to CHESS for the public	2017 – 2018
Volunteer: Science Cabaret, Coltivare, Ithaca, NY	2017
Panelist, Cosmology and Cocktails, Fleet Science Center, San Diego, CA, audience of >200	2017

## K-12 EDUCATION

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Creator, Organizer: Cosmology Day, Ithaca, NY	2019 – Present
<i>Annual half-day event for high school students, communicating real step-by-step paths from high school to careers in physics, astronomy &amp; engineering</i>	
Author, children’s book series on particle physics and astronomy, MIT Kids Press	
MIT Open Space event, “I’m a Neutrino” reading, Cambridge, MA, audience of >50	2022
“I’m a Neutrino” included in the UK’s Summer Reading Challenge for ages 4–11	2022
Invited Guest Speaker, Girl Tales Podcast Taleblazer Weekend	2022
Expanding Your Horizons Conference, Cornell University	
<i>One-day conference designed to stimulate 7<sup>th</sup>-9<sup>th</sup> grade girls’ interest in STEM</i>	
Conference Volunteer	2021
Physics Workshop Instructor	2019
Conference Buddy	2015
Volunteer, Cornell Center for Materials Research Educational Programs	2015 – 2020
<i>Educational programs and demonstrations for K-12 students, teachers, and the public</i>	
Laboratory tour for Cornell STEM Teacher Workshop, Ithaca, NY	2018
Cosmology lecture at Ithaca High School, Ithaca, NY, audience of >30	2018
Laboratory tour for New Settlement Housing Fund visiting students	2015
Volunteer, Focus For Teens, Cornell University Department of Astronomy	2011, 2014
<i>4-H STEM career exploration event for high school students</i>	
Physics Instructor, Northern Lights Learning Cooperative, Ithaca, NY	Spring 2011

## GROUPS AND ADVOCACY

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APS Inclusion, Diversity and Equity Alliance (IDEA) Workshops	2020 – Present
Team Lead, Simons Observatory Institutional Team	
Volunteer, Student Disability Services, Cornell University	2015 – 2021
<i>Advocacy for students with invisible disabilities</i>	
Member, Cornell Allergy and Asthma Awareness Club	2016 – 2017
Member, Caltech Graduate Student Council Advocacy Committee	Fall 2014
Member, Society of Physics Students, Cornell University	2010 – 2014

## PUBLICATIONS, MAIN AUTHOR

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Google Scholar Profile, h-index 26, 3412 citations

11/2022

*Publications with fifteen or more authors have the alphabetized author list shortened to et al.*

- 12) **E. M. Vavagiakis**, C. J. Duell et al. 2022, *CCAT-prime: Design of the Mod-Cam receiver and 280 GHz MKID instrument module*, Proc. SPIE 12190:1219004, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2208.05468.
- 11) Z. Huber, Y. Li, **E. M. Vavagiakis** et al. 2022, *The Simons Observatory: Magnetic Shielding Measurements for the Universal Multiplexing Module*, J. Low Temp. Phys. 2022, arXiv:2111.11495.
- 10) **E. M. Vavagiakis**, P. A. Gallardo, V. Calafut, S. Amodeo et al. 2021, *The Atacama Cosmology Telescope: Probing the Baryon Content of SDSS DR15 Galaxies with the Thermal and Kinematic Sunyaev-Zel'dovich Effects*, Phys. Rev. D 104, 043503, arXiv:2101.08373.
- 9) V. Calafut, P. A. Gallardo, **E. M. Vavagiakis** et al. 2021, *The Atacama Cosmology Telescope: Detection of the Pairwise Kinematic Sunyaev-Zel'dovich Effect with SDSS DR15 Galaxies*, Phys. Rev. D 104, 043502, arXiv:2101.08374.
- 8) C. J. Duell, **E. M. Vavagiakis** et al. 2020, *CCAT-prime: Designs and Status of the First Light 280 GHz MKID Array and Mod-Cam Receiver*, Proc. SPIE 11453:114531F, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X, arXiv:2012.10411.
- 7) **E. M. Vavagiakis** et al. 2020, *The Simons Observatory: Magnetic Sensitivity Measurements of Microwave SQUID Multiplexers*, IEEE Trans. Appl. Supercond., 31, 5, arXiv:2012.04532.
- 6) **E. M. Vavagiakis**, N. F. Cothard, J. R. Stevens, C. L. Chang, M. D. Niemack, G. Wang, V.G. Yefremenko, J. Zhang 2019, *Developing AlMn films for Argonne TES fabrication*, J. Low Temp. Phys. 199, 408–415, arXiv:1910.10199.
- 5) J. R. Stevens, N. F. Cothard, **E. M. Vavagiakis** et al. 2019, *Characterization of Transition Edge Sensors for the Simons Observatory*, J. Low Temp. Phys. 199, 672–680, arXiv:1912.00860.
- 4) **E. M. Vavagiakis** et al. 2018, *Prime-Cam: A first-light instrument for the CCAT-prime telescope*, Proc. SPIE 10708:107081U, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy IX, arXiv:1807.00058.
- 3) **E. M. Vavagiakis**, S. W. Henderson, K. Zheng et al. 2018, *Magnetic Sensitivity of AlMn TESes and Shielding Considerations for Next Generation CMB Surveys*, J. Low Temp. Phys. 193, 288–297, arXiv:1710.08456.
- 2) F. De Bernardis, S. Aiola, **E. M. Vavagiakis**, M. D. Niemack, N. Battaglia et al. 2017, *Detection of the pairwise kinematic Sunyaev-Zel'dovich effect with BOSS DR11 and the Atacama Cosmology Telescope*, JCAP 03, 008, arXiv:1607.02139.
- 1) S. C. Parshley, **E. M. Vavagiakis**, T. Nikola, G. J. Stacey 2014, *A Miniature Cryogenic Scanning Fabry-Perot Interferometer for Mid-IR to Submm Astronomical Observations*, Proc. SPIE 9147:914745, Ground-based and Airborne Instrumentation for Astronomy V.

## PUBLICATIONS, COAUTHOR

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- 69) The CCAT-prime Collaboration 2022, *CCAT-prime Collaboration: Science Goals and Forecasts with Prime-Cam on the Fred Young Submillimeter Telescope*, ApJS 264 7, arXiv:2107.10364.
- 68) Z. B. Huber, S. K. Choi, C. J. Duell, R. G. Freundt, P. A. Gallardo, B. Keller, Y. Li, L. T. Lin, M. D. Niemack, T. Nikola, D. A. Reichers, G. Stacey, **E. M. Vavagiakis**, B. Zou 2022, *CCAT-prime: the optical design for the Epoch of reionization spectrometer*, Proc. SPIE 12190:121902H, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2208.09521.
- 67) S. C. Chapman, Anthony I. Huber, Adrian K. Sinclair, Jordan D. Wheeler et al. 2022, *CCAT-prime: the 850 GHz camera for Prime-Cam on FYST*, Proc. SPIE 12190:1219005, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2208.10634.
- 66) A. I. Huber, S. C. Chapman, A. K. Sinclair, L. D. Spencer et al. 2022, *CCAT-prime: optical and cryogenic design of the 850 GHz module for Prime-Cam*, Proc. SPIE 12190:121901D, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2208.09560.
- 65) A. Sinclair, R. C. Stephenson, C. A. Roberson, E. L. Weeks, J. Burgoynea, A. I. Huber, P. M. Maukopf, S. C. Chapman et al. 2022, *CCAT-prime: RFSOC Based Readout for Frequency Multiplexed Kinetic Inductance Detectors*, Proc. SPIE 12190:121900W, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2208.07465.
- 64) B. Zou, S. K. Choi, N. F. Cothard, R. Freundt, Z. B. Huber, Y. Li, M. D. Niemack, T. Nikola, D. A. Reichers, K. M. Rossi, G. J. Stacey, **E. M. Vavagiakis** 2022, *CCAT-prime: the design and characterization of the silicon mirrors for the Fabry-Perot interferometer in the Epoch of reionization spectrometer*, Proc. SPIE 12190:121902B, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy XI, arXiv:2207.08318.
- 63) E. Healy, D. Dutcher et al. 2022, *The Simons Observatory 220 and 280 GHz Focal-Plane Module: Design and Initial Characterization*, J. Low Temp Phys 2022, arXiv:2201.04507.
- 62) J. Connors et al. 2022, *Magnetic Field Sensitivity of Microwave SQUID Multiplexers*, J. Low Temp Phys 2022.
- 61) S. K. Choi, C. J. Duell et al. 2022, *CCAT-prime: Characterization of the First 280 GHz MKID Array for Prime-Cam*, J. Low Temp. Phys. 2022, arXiv:2111.01055.
- 60) The CMB-S4 Collaboration 2021, *Snowmass 2021 CMB-S4 White Paper*, arXiv:2112.01458.
- 59) J. C. Hill, E. Calabrese et al. 2021, *The Atacama Cosmology Telescope: Constraints on Pre-Recombination Early Dark Energy*, Phys. Rev. D 105, 123536, arXiv:2109.04451.
- 58) H. McCarrick, E. Healy et al. 2021, *The Simons Observatory microwave SQUID multiplexing detector module design*, ApJ 922 38, arXiv:2106.14797.
- 57) T. Shin, B. Jain et al. 2021, *The mass and galaxy distribution around SZ-selected clusters*, MNRAS, 507, 4, arXiv:2105.05914.

- 56) J. Orlowski-Scherer, L. Di Mascolo, T. Bhandarkar, A. Manduca, T. Mroczkowski et al. 2021, *Atacama Cosmology Telescope: Measurements of a large sample of candidates from the Massive and Distant Clusters of WISE Survey: Sunyaev-Zeldovich effect confirmation of MaDCoWS candidates using ACT*, A&A 653, A135, arXiv:2105.00068.
- 55) Y. Guan, S. E. Clark, B. S. Hensley, P. A. Gallardo, S. Naess, C. J. Duell et al. 2021, *The Atacama Cosmology Telescope: Microwave Intensity and Polarization Maps of the Galactic Center*, ApJ, 920, 6, arXiv:2105.05267.
- 54) Z. Xu et al. 2021, *The Simons Observatory: the Large Aperture Telescope (LAT)*, Res. Notes AAS 5 100, arXiv:2104.09511.
- 53) N. Zhu et al. 2021, *The Simons Observatory Large Aperture Telescope Receiver*, ApJS 256, 23, arXiv:2103.02747.
- 52) S. Amodeo, N. Battaglia, E. Schaan, S. Ferraro, E. Moser et al. 2021, *The Atacama Cosmology Telescope: Modelling the Gas Thermodynamics in BOSS CMASS galaxies from Kinematic and Thermal Sunyaev-Zel'dovich Measurements*, Phys. Rev. D 103, 063514, arXiv:2009.05558.
- 51) E. Schaan, S. Ferraro, S. Amodeo, N. Battaglia et al. 2021, *The Atacama Cosmology Telescope: Combined kinematic and thermal Sunyaev-Zel'dovich measurements from BOSS CMASS and LOWZ halo*, Phys. Rev. D 103, 063513, arXiv:2009.05557.
- 50) Y. Li et al. 2021, *In situ Performance of the Low Frequency Array for Advanced ACTPol*, IEEE Trans. Appl. Supercond., 31 (5), arXiv:2101.02658.
- 49) M. Hilton, C. Sifón, S. Naess, M. Madhavacheril, M. Oguri, E. Rozo, E. Rykoff et al. 2021, *The Atacama Cosmology Telescope: A Catalog of >4000 Sunyaev-Zel'dovich Galaxy Clusters*, ApJS 253 (1), arXiv:2009.11043.
- 48) Z. Xu et al. 2020, *The Simons Observatory: the Large Aperture Telescope Receiver (LATR) integration and validation results*, Proc. SPIE. 11453:1145315, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X, arXiv:2012.07862.
- 47) E. Healy et al. 2022, *Assembly development for the Simons Observatory focal plane readout module*, Proc. SPIE 11453:1145317, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X, arXiv:2204.05869.
- 46) J. Seibert et al. 2020, *Development of an optical detector testbed for the Simons Observatory*, Proc. SPIE 11453:114532C, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X.
- 45) K. Harrington, C. Sierra, G. Chesmore, S. Sutariya et al. 2020, *The integration and testing program for the Simons Observatory Large Aperture Telescope optics tubes*, Proc. SPIE 11453:1145318, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X, arXiv:2102.02129.
- 44) D. Henke, D. Johnstone, L. B. G. Knee, S. Chapman, C. Ross, M. Fich, T. Nikola, S. K. Choi, M. D. Niemack, S. C. Parshley, G. J. Stacey, **E. M. Vavagiakis** 2020, *Optical design study for the 860 GHz first-light camera module of CCAT-p*, Proc. SPIE 11453:114532K, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X.



- 43) N. F. Cothard et al. 2020, *Comparing complex impedance and bias step measurements of Simons Observatory transition edge sensors*, Proc. SPIE 11453:1145325, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy X, arXiv:2012.08547.
- 42) M. S. Madhavacheril, C. Sifón, N Battaglia et al. 2020, *The Atacama Cosmology Telescope: Weighing distant clusters with the most ancient light*, ApJL 903, L13, arXiv:2009.07772.
- 41) The CMB-S4 Collaboration 2020, *CMB-S4: Forecasting Constraints on Primordial Gravitational Waves*, arXiv:2008.12619.
- 40) S. Naess et al. 2020, *The Atacama Cosmology Telescope: arcminute-resolution maps of 18,000 square degrees of the microwave sky from ACT 2008-2018 data combined with Planck*, JCAP 2020, 046, arXiv:2007.07290.
- 39) S. K. Choi, M. Hasselfield, S. P. Ho, B. Koopman, M. Lunguet et al. 2020, *The Atacama Cosmology Telescope: A Measurement of the Cosmic Microwave Background Power Spectra at 98 and 150 GHz*. JCAP 2020, 045, arXiv:2007.07289.
- 38) S. Aiola, E. Calabrese, L. Maurin, S. Naess, B. L. Schmitt et al. 2020, *The Atacama Cosmology Telescope: DR4 Maps and Cosmological Parameters*, JCAP 2020, 047, arXiv:2007.07288.
- 37) A. Suzuki, N. Cothard, A. T. Lee, M. D. Niemack, C. Raum, M. Renzullo, T. Sasse, J. Stevens, P. Truitt, **E. M. Vavagiakis**, J. Vivalda, B. Westrook, D. Yohannes 2020, *Commercially Fabricated Antenna-Coupled Transition Edge Sensor Bolometer Detectors for Next-Generation Cosmic Microwave Background Polarimetry Experiment*, J. Low Temp. Phys. 199, 1158–1166, arXiv:1912.12782.
- 36) M. S. Madhavacheril, J. C. Hill, S. Naess et al. 2019, *The Atacama Cosmology Telescope: Component-separated maps of CMB temperature and the thermal Sunyaev-Zel’dovich effect*, Phys. Rev. D 102 2, 023534, arXiv:1911.05717.
- 35) S. Choi et al. 2019, *Sensitivity of the Prime-Cam Instrument on the CCAT-prime Telescope*, J. Low Temp. Phys. 199, 1089–1097, arXiv:1908.10451.
- 34) N. F. Cothard, S. K. Choi, C. J. Duell, T. Herter, J. Hubmayr, J. McMahon, M. D Niemack, T. Nikola, C. Sierra, G. J. Stacey, **E. M. Vavagiakis**, E. J Wollack, B. Zou 2019, *The Design of The CCAT-Prime Epoch of Reionization Spectrometer Instrument*, J. Low Temp. Phys. 199, 898–907, arXiv:1911.11687.
- 33) M. S. Rao, M. Silva-Feaver et al. 2019, *Simons Observatory Microwave SQUID Multiplexing Readout - Cryogenic RF Amplifier and Coax Chain Design*, J. Low Temp. Phys. 199, 807-816, arXiv:2003.08949.
- 32) Y. Li et al. 2019, *Assembly and Integration Process for the High-Density Detector Array Readout Modules for the Simons Observatory*, J. Low Temp. Phys. 199, 985-993.
- 31) The Simons Observatory Collaboration 2019, *The Simons Observatory: Astro2020 Decadal Project Whitepaper*, Astro2020 Decadal Project White Paper, Bull. Am. Astron. Soc. 51 147, arXiv:1907.08284.

- 30) K. Basu et al. 2019, “*SZ spectroscopy*” in the coming decade: *Galaxy cluster cosmology and astrophysics in the submillimeter*, Astro2020 Decadal Project White Paper, arXiv:1903.04944.
- 29) The CCAT-prime Collaboration 2019, *The CCAT-Prime Submillimeter Observatory*, Astro2020 APC White Paper, arXiv:1909.02587.
- 28) The Simons Observatory Collaboration 2018, *The Simons Observatory: Science goals and forecasts*, JCAP 1902, 056, arXiv:1808.07445.
- 27) G. Coppi, Z. Xu, et al. 2018, *Cooldown strategies and transient thermal simulations for the Simons Observatory*, Proc. SPIE 10708:1070827, Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy IX, arXiv:1808.07896.
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